WRC-CANX
CAN Bus Extender
Series 4
User's Manual

Western Reserve Controls, Inc.

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1.   Overview

The WRC-CANX Extenders is a family of products that extend the communications cable lengths for DeviceNet, SDS (Smart Distributed System), J1939, CANopen and other CAN, V2.0, Part A or Part B serial bus systems. By allowing the user to extend the bus length for any given speed, they assist the user in cost-effectively implementing I/O or other nodes on these buses at remote locations that would be more difficult or more expensive to do otherwise.

A WRC-CANX Extender (the family members collectively referred to here as CANX or Extender) can be connected in a bus trunk line or drop line and is transparent to the other nodes on the bus. It receives and actively re-transmits (store-and-forward) each message from either side of the network without interpreting the message or acting upon it.

Each product has two network interfaces with an electrical isolation path between the two. Power is delivered to the unit through the network connectors. For DeviceNet and SDS systems power is provided through the 5-conductor bus cable.

A CANX can be used for quite a number of helpful purposes, including

- to extend the network beyond its absolute maximum length (e.g., 500 meters for DeviceNet) at the slowest speed

- to implement a longer network for a given baud rate (e.g., pushing a 500K baud network beyond 100 m for DeviceNet)

- to provide higher speed baud rates for a given network length

- to extend the length of the drop cable (e.g., longer drops than 6 m for DeviceNet)

- to provide 2600V electrical isolation between the 2 sub-nets

- to create a unique network topology instead of a conventional bus structure, such as a star configuration
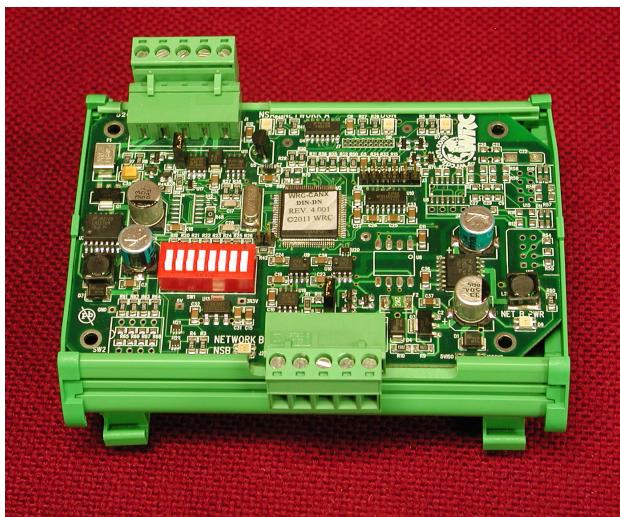
Figure 1-1 WRC-CANX-DIN-DN Series 4

1.1.   Series 4 Specific Features

The Series 4 CANX provides enhancements over previous versions. Enhancements include:

* CAN 2A and 2B support
* New Switch settings allow selection for CANopen speeds up to 1 M Baud in addition to the standard DeviceNet Baudrates
* Increased message internal buffers – Automatic Memory Technology (AMT) operation
* Shorter latency time compared to CANX series 3
* Improved Reverse voltage protection and Can data lines noise immunity
* Jumper-selectable terminating resistors on-board the CANX

1.2.   Features

The WRC-CANX has the following features:

Extends CAN-Bus cable lengths - trunk line or drop lines
Allows operation at higher speeds for specific distances
Expands the usable applications for CAN-Bus systems
Operates at 9.6K, 10K, 20K, 40K, 50K, 100K 125K, 250K, 500K, 800K and 1M baud
Operates up to 1M baud for other CAN protocols
No configurable parameters
Automatic baud rate selection
No address selection required
Isolates the two sides of the bus - 2500 volts
Logically transparent to the Master and Slave devices on the bus
DeviceNet; SDS; CANopen, J1939, CAN, V2.0, Part A and Part B compatible
Powered from the 24Vdc supplied by bus network or the user
Two mechanical packages:

	DIN rail mount:	WRC-CANX-DIN
	Sealed NEMA-4X enclosure:	WRC-CANX-NEM

5-pin pluggable connection for the DIN mount unit
5-pin round mini-style connection for the NEMA mount unit
Standard CAN chips manage bus error detection
Standard CAN chips handle message bus contention
Less than 100 μsec latency
4 bi-color (red/green) status LED's
CE Compliant for WRC-CANX-NEM-xx versions
EN 55011 Class A
EN 50082-2: 1994

1.3.   Basic Operation

There are two bus connections for each CANX, referred to as Network A and Network B. The CAN Bus is connected to each side of the CANX and each side receives its power and signals from the Bus on its respective side. See

Figure **1-2** for a typical application.

Whenever a message is transmitted on the Bus to which CANX is connected, CANX receives the message on the side where it was initiated and performs a store-and-forward of the message to the other side. It then transmits the message to the bus on the other side, following the defined bus arbitration rules. This action is performed for any valid CAN message independent of who generated it or to whom it is intended.

There is approximately a 75 µsec propagation delay of the message through the CANX.

The CANX is not addressed as a specific device on the Bus and cannot be interrogated by other nodes. It is transparent to all other nodes on the bus.
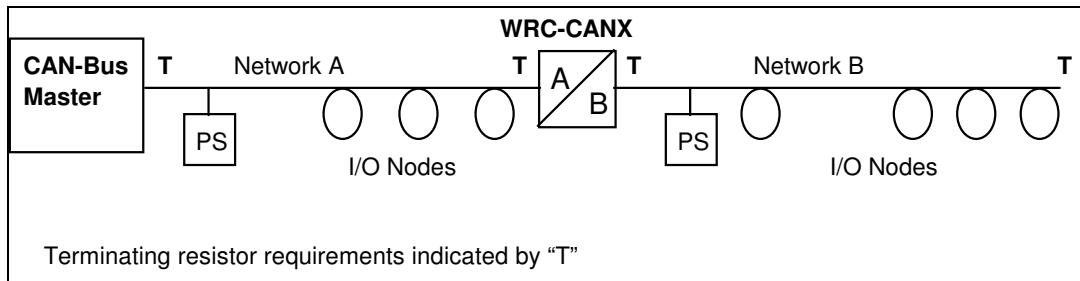
Figure 1-2 Typical CANX network configuration

1.4.   *Reference Documents*

The following documents are referenced in this User's Manual

* ODVA DeviceNet Specification Volume I, Release 2.0 or CIP specification Volume 3

* Honeywell Micro Switch Specification GS 052 104, "SDS Smart Distributed System Physical Layer Specification", release date 12/8/1994

2. Quick Start

To quickly and easily install your CAN-Bus Extender in your DeviceNet system, follow the instructions below. For more details, see Section 4.

To Install and Establish Communications

1. Remove the CAN-Bus Extender from the box and connect your CAN-Bus cable to the 5-pin plugs (supplied with CANX-DIN) or the mini-style connectors (user-supplied) according to wiring specifications for the CAN Bus you are using and described later in this manual.

2. Leave the DIP switches in the FF or all OPEN positions. The DIP switches are set to autobaud both A and B sides from the first valid CAN message on either side.

3. Using on-board jumpers W1 and W3, terminate each side of the CAN-Bus network, as appropriate. (This is especially critical at the higher baud rates.)

4. The CANX does not differentiate between A side and B side from a functional perspective. The CANX can be oriented with either side toward the Master.

5. Make sure that there is power on both network sides. (The CANX isolated power and signal.)

6. Plug the CANX into your network.

7. The CAN-Bus Extender will undergo its initialization sequence, flashing the LED's. After approximately 5 seconds, the Module Status LED (labeled "MS") will go on solid green and network LED's (labeled "NSA" and "NSB") will flash green.

8. Both Network A and B Status LED's (NSA and NSB) will go on solid once a valid CAN message is received into either side of the Extender and the baudrate auto-detect has been successfully performed.

9. The CAN-Bus Extender is now operating on the network and is ready to repeat messages from either Network A or Network B.

3.　　General Specifications

Product:	WRC-CANX-DIN and WRC-CANX-NEM CAN-Bus Extender, Series 4
Description:	Electrical extender to extend the permitted cable distances defined for CAN-based network products
Device Type:	Communications Extender
Product Revision:	4.1

DeviceNet Conformance:	Designed to conform to the ODVA DeviceNet Specification Version 2.0.
Baud rate:	9.6K, 10K, 20K, 40K, 50K, 100K 125K, 250K, 500K, 800K and 1M baud fixed or auto-detect baud rate on DeviceNet
Address selection:	Not applicable

Bus Connection:

WRC-CANX-DIN
Extender:	5-pin pluggable header (male pins)	
	Phoenix Contact MSTBA 2.5/5-G-5.08/AU	
CAN-Bus Cable:	5-contact plug (female contacts)	
	Phoenix Contact MSTB 2.5/5-ST-5.08/AU (included)	

WRC-CANX-NEM
Extender:	Woodhead # 51354, female sockets, female threads
	Woodhead # 1R5006A17A120, male pins, male threads
CAN-Bus Cable:	See accessories list

Status Indicators:
Module Status:	green/red bi-color LED
Network A Status:	green/red bi-color LED
Network B Status:	green/red bi-color LED
Diagnostic Data:	green/red bi-color LED

Voltage Isolation:	2500 V

Maximum power:
Voltage:	11 - 25 Vdc	
Current:	Network A:	110 mA @ 11 Vdc - 60 mA @ 25 Vdc
	Network B:	20 mA @ 11 Vdc - 10 mA @ 25 Vdc
Power: 1.5 W		

Mounting:
WRC-CANX-DIN:	DIN rail mount, EN 50022
WRC-CANX-NEM:	Panel-mount, 4 screws

Size:
	WRC-CANX-DIN	WRC-CANX-NEM
Length:	4.32" (110 mm)	5.11" (130 mm)
Depth:	1.79" (45,5 mm)	2.27" (57,7 mm)
Height:	3.44" (87,4 mm)	3.70" (94,0 mm)

Operating Temp:	0-70 ºC
Humidity:	0-95% RH, non-condensing

4. Hardware Installation and Configuration

4.1. Overview

A CAN-Bus Extender is a single device connecting to two parts (sub-network) of a single CAN-Bus network. The CANX-DIN is to be mounted on an EN50022 DIN rail (available from WRC and WRC's distributors as part number WRC 50022) in any orientation. The CANX-NEM is a NEMA-4X polycarbonate enclosure and is panel mounted.
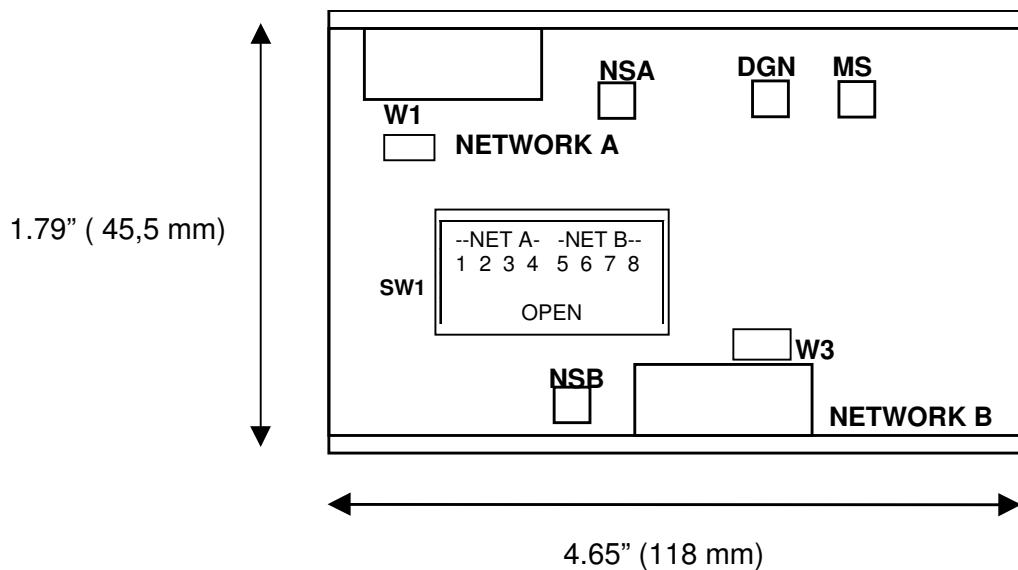
Figure 4-1   WRC-CANX-DIN Series 4 Dimensional Drawing
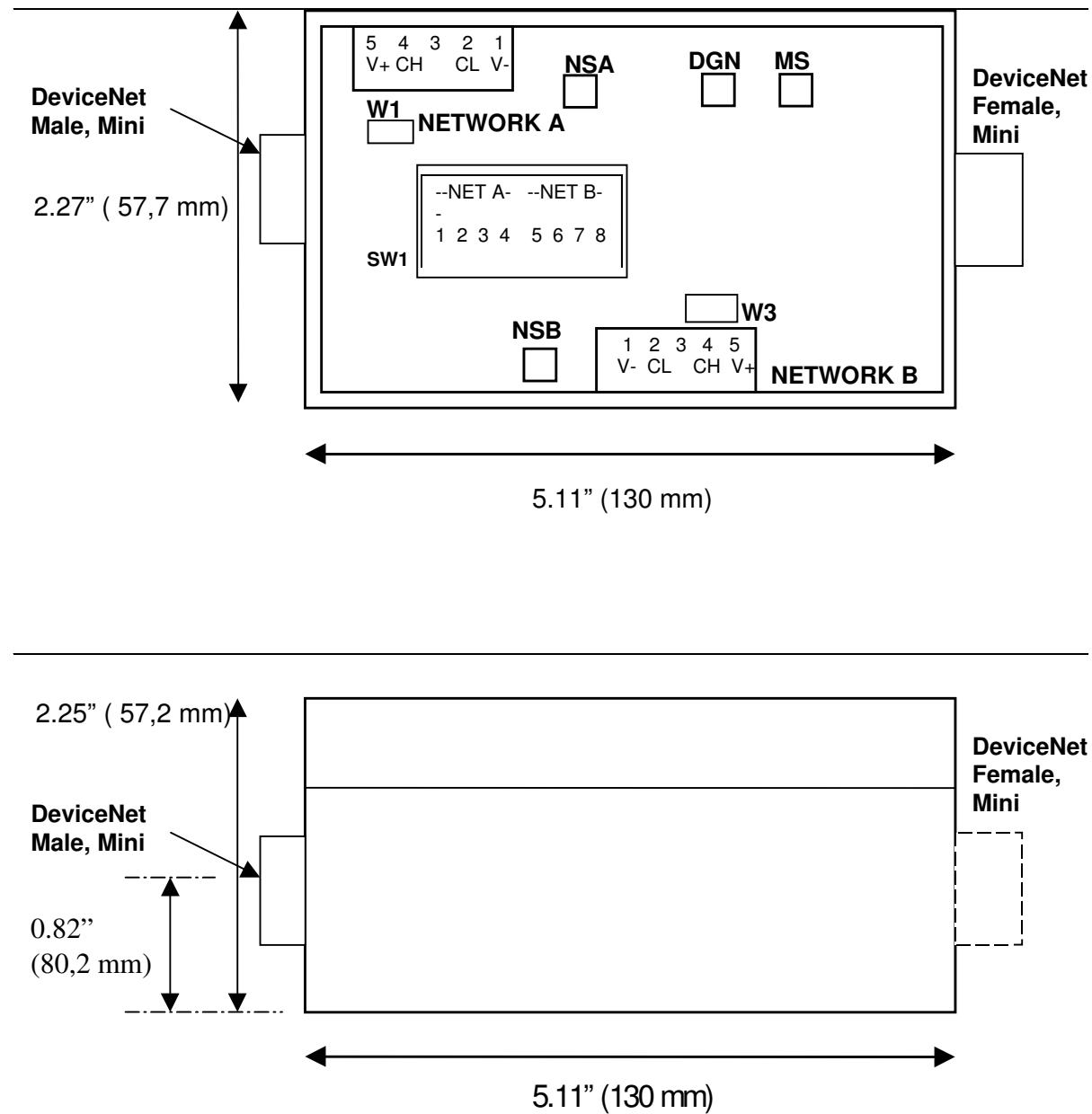
Figure 4-2   WRC-CANX-NEM Series 3 Dimensional Drawing

4.2.   DIP Switch Settings

The WRC-CANX-XX has an 8-pole DIP switch.

- Switch positions 1-4 are used to set the Network A baud rate.
- Switch positions 5-8 are used to set the Network B baud rate.

The baud rates can be set independently, or one side can take its baud rate from the other side (in the "Remote" setting).

The Autobaud detects from DeviceNet bauds.

For CANopen speeds, select the fix baudrate setting.

When both the CANX units are set to all open switch positions (remote-remote) it scans through DeviceNet baudrates.

Table 4-1 Baud Rate Settings for Switches

Baud rate	Local	Position 1	Position 2	Position 3	Position 4	Meaning
	Remote	Position 5	Position 6	Position 7	Position 8	
125K		CLOSED	CLOSED	CLOSED	CLOSED	Fixed
250K		CLOSED	CLOSED	CLOSED	**OPEN**	Fixed
500K		CLOSED	CLOSED	**OPEN**	CLOSED	Fixed
Autobaud		CLOSED	CLOSED	**OPEN**	**OPEN**	Autobaud for DeviceNet Bauds (125k,250k,500k)
9.6K		CLOSED	**OPEN**	CLOSED	CLOSED	Fixed
10K		CLOSED	**OPEN**	CLOSED	**OPEN**	Fixed
20K		CLOSED	**OPEN**	**OPEN**	CLOSED	Fixed
40K		CLOSED	**OPEN**	**OPEN**	**OPEN**	Fixed
50K		**OPEN**	CLOSED	CLOSED	CLOSED	Fixed
100K		**OPEN**	CLOSED	CLOSED	**OPEN**	Fixed
800K		**OPEN**	CLOSED	**OPEN**	CLOSED	Fixed
1M		**OPEN**	CLOSED	**OPEN**	**OPEN**	Fixed
Remote		**OPEN**	**OPEN**	**OPEN**	**OPEN**	Takes baud rate from the opposite end device. If both sides are remote, Autobaud from either side.
Autobaud		ALL OTHER SWITCH POSITIONS				Autobaud

4.3. LED Operation

The WRC-CANX-XX Multiplexer has four (4) LED's that provide visual status information to the user about the product and the DeviceNet network.   See Figure 4-1, Table 4-2, Table 4-3 and Table 4-4.

Table 4-2 Module Status LED (labeled MS)

LED State	Module Status	Meaning
OFF	No Power	There is no power through DeviceNet.
Green	Device Operational	WRC-CANX is operating normally.
Flashing Red	Minor Fault	Advanced Memory Technology (AMT) buffers space exceeded.
Red	Unrecoverable Fault	WRC-CANX may be damaged.
Flashing Red/Green	Device Self-Testing	WRC-CANX is in self-test mode.

Table 4-3 Network Status LED's (labeled NSA and NSB)

LED State	Module Status	Meaning
OFF	No Power / Not on-line	WRC-CANX has no power or device is not operating.
Flashing Green	Idle	WRC-CANX has not received a valid message for 0.5 sec.
Fast Flashing Green	Autobaud selection	The WRC-CANX is waiting for a valid message to fix the baudrate.
Green	On-line	WRC-CANX is operating normally.
Flashing Red	CAN controller buffer overflow	There is more traffic on the network than the system can handle.
Red	Critical link failure (Bus Off)	WRC-CANX has detected an error that makes it incapable of communicating on the link.

Table 4-4 Diagnostic Status LED's (labeled DGN)

LED State	Module Status	Meaning
OFF	Normal operation	No Power, or Normal Operation with power applied.

4.4. Power Requirements

The WRC-CANX-XX CAN-Bus Extender subsystem is powered from the 11-25 Vdc provided by the DeviceNet network. The WRC-CANX consumes 60 mA of current at 25 Vdc, or 1.5 Watts, typical. See Section 3.

Power is typically taken from the bus on each side and each side (A and B) requires power. Power applied to the A Side powers the entire unit except the B Side isolated transceiver. If isolation is not required for your application, then the power line may be jumpered from side A to side B. Care must be taken that the power supply is capable of handling the entire load on both sides of the CANX.

4.5. Network Cabling and Configuration

This section provides general guidelines for connecting DeviceNet and SDS systems. You can find detailed specifications in the appropriate ODVA DeviceNet and Honeywell SDS specifications.

4.5.1. Cable Lengths

The following provide cable length limits for DeviceNet and SDS systems.

Table 4-5 Network Maximum Lengths - DeviceNet

Baud Rate	Trunk Line Length		Drop Length			
	Maximum Distance		Maximum		Cumulative	
	Meters	Feet	Meters	Feet	Meters	Feet
125 Kbits/s	500 m	1640 ft	6 m	20 ft	156 m	512 ft.
250 Kbits/s	250 m	820 ft	6 m	20 ft	78 m	256 ft.
500 Kbits/s	100 m	328 ft	6 m	20 ft	39 m	128 ft.

DeviceNet has a limit of 64 nodes per network for any baud rate. The CANX does not count as an addressed device.

Table 4-6 Network Maximum Lengths - SDS

Baud Rate	Trunk Line Length (maximum)		Drop Length (maximum)		No. Nodes
	Meters	Feet	Meters	Feet	
125 Kbits/s	457.2	1500	3.6	12	64
250 Kbits/s	182.8	600	1.8	6	64
500 Kbits/s	91.4	300	0.9	3	64
1 Mbits/s	22.8	75	0.3	1	32

SDS has a limit of 32 nodes per network for any baud rate. The CANX does not count as an addressed device.

4.5.2. Network Termination

A CAN-Bus system **must be terminated at each end of the trunk line**. The host controller and the **last** device (CAN-Bus Extender or other DeviceNet node) on the network section must always be terminated to eliminate reflections, even if only two nodes are present. Follow the information below when using a CANX.

The CANX Series 4 has built-in terminators, which can selectively included or omitted from the network. To include the on-board terminator on side A, install jumper W1; or remove the W1 jumper if the

on-board terminator in not desired. For the side B sub-network, install or remove jumper W3. The CANX is shipped from the factory with the jumpers installed.

Trunk line use

For the purpose of network termination, the CANX is treated as the last node on the section of the trunk network to which it is connected. Therefore, when a CANX is used directly in a trunk line, it must be terminated on both the Network A and Network B sides. You must also place a terminating resistor on the other end device of Network A and on the last device on Network B side of the trunk line.

Drop line use

When CANX is used in a drop line (the Network A side is toward the main trunk), the Network A connection is **not** terminated. In this configuration the Network B section is considered as an independent bus line electrically. The CANX, as the first node in this new bus line and must be terminated, and the last device on the line must also be terminated.

Some specifications for the terminating resistor are:

Table 4-7 Terminating Resistors

DeviceNet	SDS
121 ohm	120 ohm
1% metal film	2%
1/4 watt	1/4 watt

Important: Per the DeviceNet and SDS specs -- do not terminate devices on drop lines.

An appropriate terminating resistor kit, WRC part number RM121DN, which satisfies both DeviceNet and SDS specs, is included with your Extender.

Note: The WRC-CANX Series 4 family is configured at the factory with 2 **internal terminating resistors** on each network – one for Network A and one for Network B – using jumpers W1 and W3. If these are used in a trunk line, no other terminators should be placed at the CANX that end of the network.

Note: If the CANX is used on a **drop line**, the internal terminating resistor should be removed on Network A – the drop line directly from the trunk line.

4.5.3. DeviceNet Connection Wiring

The supplied 5-pin CAN-Bus connection plug accepts cable sizes from 12 AWG - 24 AWG. The maximum wire size (12 AWG) has an area of 6530 circular mils and the smallest (24 AWG) has an area of 3265 circular mils.
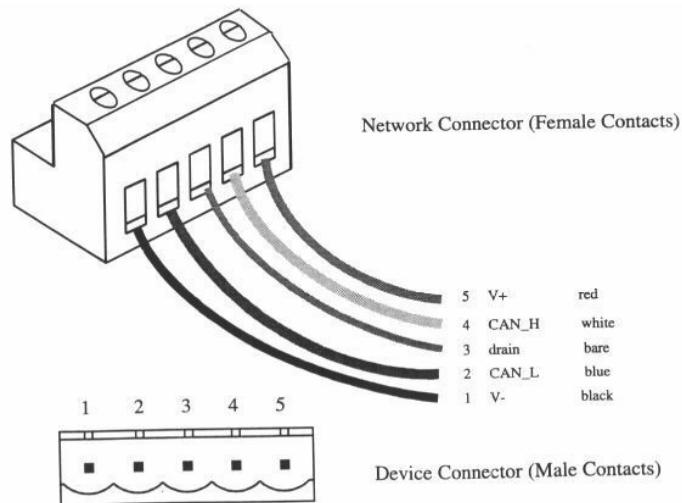
Figure 4-3   WRC-CANX-DIN-DN DeviceNet cable connector
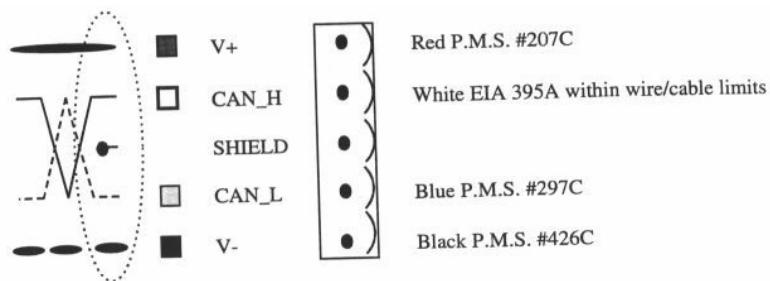
Figure 4-4   DeviceNet cable specifications
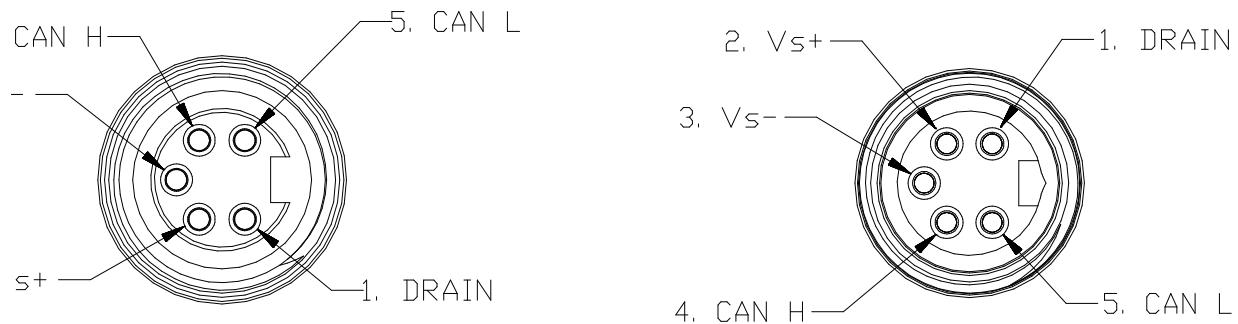
Figure 4-5 WRC-CANX-NEM DeviceNet Connectors

4.5.4. SDS Bus Connection Wiring

The supplied 5-pin CAN-Bus connection plug accepts cable sizes from 12 AWG - 24 AWG. The maximum wire size (12 AWG) has an area of 6530 circular mils and the smallest (24 AWG) has an area of 3265 circular mils.

Termination Resistor
(non-inductive)
120 ohms
1/2 W, 2%

BUS CONNECTIONS

(Black) CAN_H

(White) CAN_L

SHIELD

1 2 3 4 5

DC POWER

GND   (Blue)

V+   (Brown)
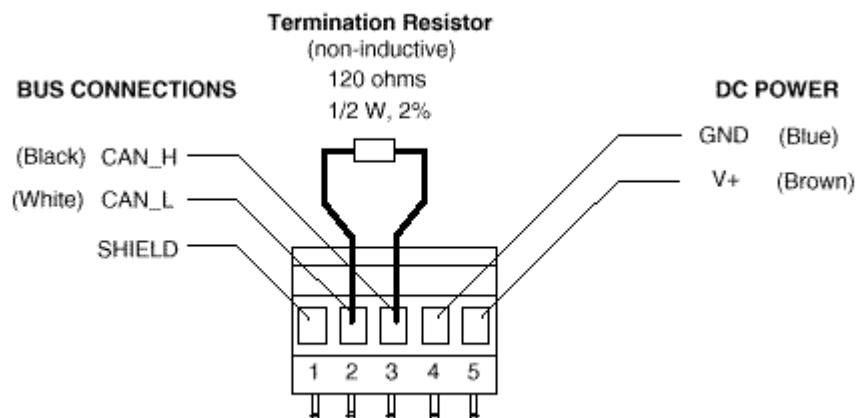
Figure 4-7 SDS Plug Connector

FACE VIEW OF
MALE
MINI CONNECTOR

1   5

2   4

3

FACE VIEW OF
FEMALE
MINI CONNECTOR

5   1

4   2

3
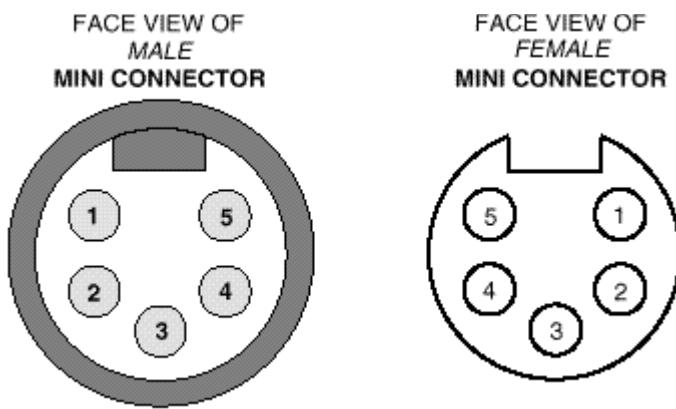
Figure 4-6 SDS Mini Connector

5.   Operation

The CANX accepts and stores messages received at either network connection and actively re-transmits the messages to the other sub-net while providing 2500V isolation between the two sections of the network. The two bus connections for each CANX are referred to as Sub-Network A and Sub-Network B, and the two sub-nets are one logical network with isolation between them. The CANX may be used to extend the maximum distance that a network can operate at any given speed. That is a CANX may be used

- to extend the network beyond its absolute maximum length (e.g., 500 meters for DeviceNet) at the slowest speed

- to implement a longer network for a given baud rate (e.g., pushing a 500K baud network beyond 100 m for DeviceNet)

- to provide higher speed baud rates for a given network length

- to extend the length of the drop cable (e.g., longer drops than 6 m for DeviceNet)

- provide 2500V electrical isolation between the 2 sub-nets

The CAN Bus is connected to each side of the CANX and each side receives its power and signals from the Bus on its respective side.

Whenever a message is transmitted on the Bus to which CANX is connected, CANX receives the message on the side where it was initiated and performs a store-and-forward of the message to the other side. This action is performed for any valid CAN message independent of who generated it or to whom it is addressed.

The CANX is not addressed as a specific device on the Bus and cannot be interrogated by other nodes. It is transparent to all other nodes on the bus.

5.1.   Application Notes

To help insure ease of installation and reliable operation of your system, the following guidelines should be followed CANX installation in your CAN network.

You may install the Network A side or B Side of CANX toward the Bus Master.

The CANX takes its logic power from the A Side, but you may power up the CANX from either side first.

There is approximately a 75 µsec propagation delay of the message through the CANX.

In autobaud mode, each side can autobaud from the other side or from the first message on its own side.

 CANX is not a grounded device and the Bus shield is not connected electrically to the device. Therefore, follow appropriate wiring practices to eliminate noise and other problems.

5.1.1. CANX Theory of Operation

As described the CANX performs a store-and-forward operation on each message received. The operation is described in this section.

The CANX will verify and accept (consume) on either network side any and all valid CAN messages. The message will be momentarily stored internally and the CANX will immediately attempt to re-send (produce) the message on the other side bus. Because the other side of the CANX is a different bus electrically and from a data link perspective, it will perform a negotiation session on that bus section to retransmit (produce) the message onto that section. This action has the effect of doubling the overall number of total attempts to get onto the bus of each message. This is the case because every message is reproduced independent of where the target node exists; that is, the CANX does not interrogate the message to determine the target node and does not know physically where the target node is connected.

As the bus negotiation is performed on the second side, the retransmitted message may or may not get on the next bus section immediately. That will depend solely upon the priority of the message the CANX is sending with respect to the messages being generated by nodes on that side of the bus and on the amount of overall bus traffic on that side. In the case where the CANX does not immediately win the negotiation it stores the messages and attempts to resend it in the same fashion as any other device on the network. To the extent that it cannot produce immediately the message will be stored in an internal buffer until it can be sent.

As other messages arrive at the CANX they also are put into an internal buffer and retransmitted as quickly as possible. The internal buffers (one for each side) are FIFO buffers so that the messages for each side will be retransmitted in the order that they are received with respect to the other messages received on the same side. Up to 100 messages can be held in the internal AMT buffers.

5.1.2. Network Throughput Design Considerations

The effect of the operations described above and the internal propagation delay inside the CANX (approximately 75us) as it performs the store-and-forward is that it may be possible to design a network with more traffic that the CANX can be expected to handle. Care should be taken to design the network so that the amount of total traffic does not exceed the capabilities of the total system. Each application and installation has its own requirements and configurations so a definitive formula would be very difficult to define. However, a good rule of thumb would be to set up the scan time for a network that includes a CANX that is no faster that twice the fastest scan time possible to achieve the desired communications that may be obtained without the CANX.

In the event that the network operation prevents all messages on one side from getting out before the buffer on that side fills, subsequent messages will be lost. The CANX will continue to process transmitting all stored messages and will accept new messages once room clears in the buffer. The red LED labeled NSA or NSB will illuminate and will remain illuminated for 5 seconds after the "buffer full" condition clears.

5.1.3. Fixed Operation

Fixed baud rate operation has the specific advantage that it can be used in networks where all devices are autobaud only.

The baud rate is set by setting SW1 switch positions before powering up the A side of the CANX. See Table 4-1.

5.1.4. Autobaud Operation

Autobaud is the method by which a device automatically determines the baud rate on the DeviceNet network and sets it's internal baud rate to match without the need for switches or software configuration. The CANX supports autobaud.

Autobaud operation has the advantage of allowing a system implementer or designer to ignore the operating baud rate when installing the CANX. The general practice is that when an I/O device is autobaud, it does not transmit a DupMacID request message immediately upon power up. It waits for another (fixed baud rate) device to send its DupMacID message in order use that message to determine to which baud rate the network has been set.

Since the CANX is not a logical node on DeviceNet, it does not initiate any DeviceNet communications. When both the A and B sides are set to autobaud, a valid message on either side will be used to set the baud rate on both sides. In addition, that message is transmitted out the other side of the network to the nodes there, from which they can establish their baud rates if in autobaud.

In the case where no device that initiates this DupMacID sequence, all the autobaud devices will just wait for some valid message to be generated.

The CANX baud rate is set by setting SW1 switch positions before powering up the A side of the CANX, as defined in Table 4-1.

6.   Example Configurations

Examples of valid configurations are shown in the following figures. The first example shown demonstrates a standard linear bus structure for comparison.

• Linear Bus Topology
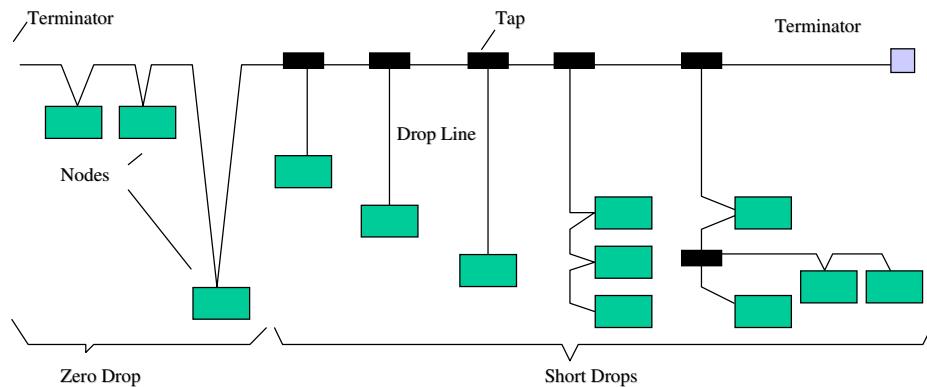
Figure 6-1 Linear Topology Example

• Linear Bus Topology - distance doubled
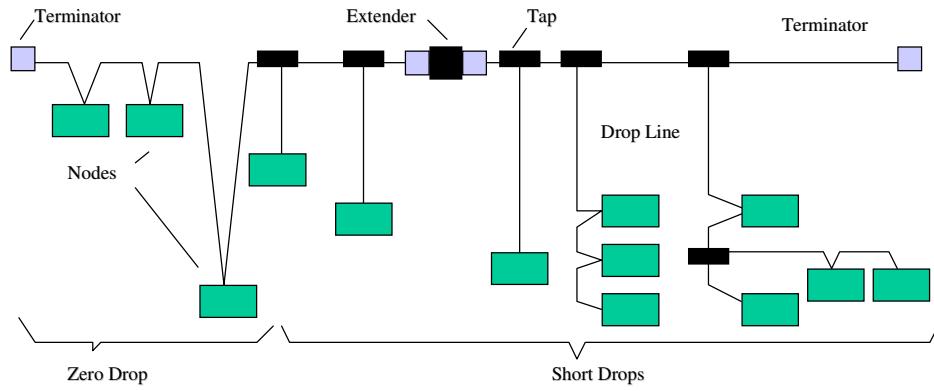
Figure 6-2 Linear Topology with Double Distance Example

• Linear Bus Topology - multiple Extenders
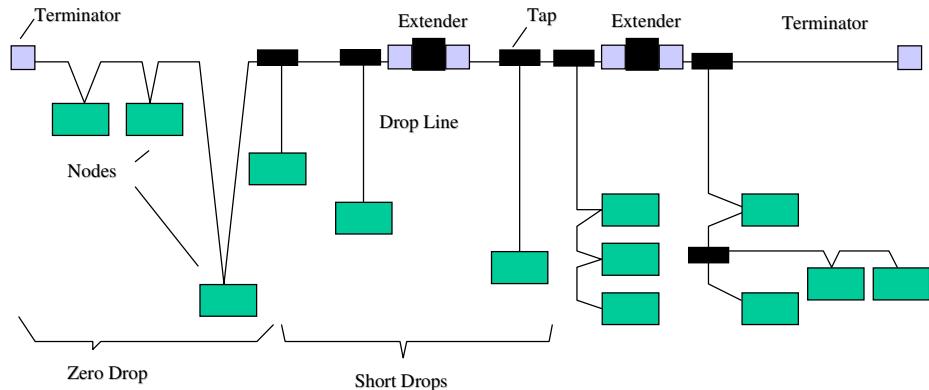
Figure 6-3 Linear Topology with Multiple Extenders Example

- # Linear Bus Topology - multiple extended drop lines

Terminator

Tap

Terminator

Drop Line

Extender

Extender

Nodes

Zero Drop

Short Drops
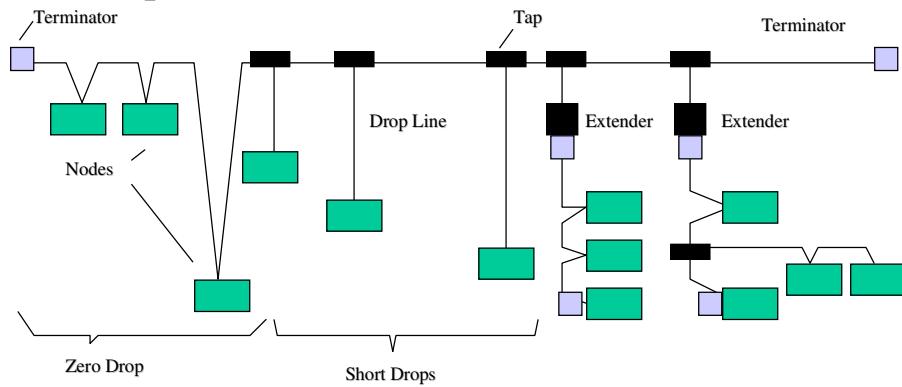
Figure 6-4 Linear Topology with Multiple Extended Drop Lines Example

- # Modified Star Topology - multiple extended drop lines

Host PLC
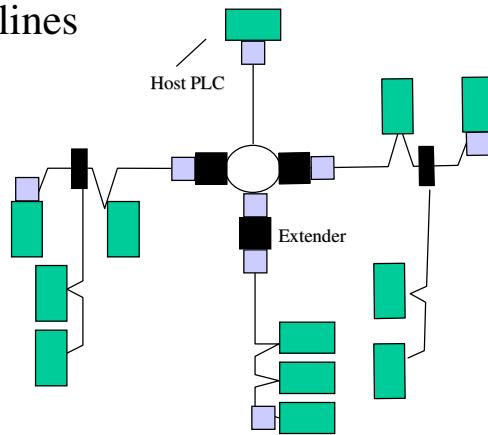
Extender

Figure 6-5 Star Topology with Multiple Drop Lines Example

7. Accessories and Other CAN Products

The following components can be used with a WRC-CANX CAN-Bus Extender for replacements or spare parts.

Part	WRC P/N	Equivalent Mfr. Part Number
• CANX-DIN Link Connector and Terminator Resistor	CANX-DN-CK	Phoenix Contact MSTB2.5/5-ST-5.08/AU
• CANX-NEM Cable	n/a	Various manufacturers' Mini-Style Connector
		Examples:
		Cable assy. w/ female threads, fem. sockets: Turck RKM 570-*M/630 ("trunk line") Turck RKM 571-*M/630 ("drop line")
		Cable assy. w/ male threads, male pins: Turck RSM 570-*M/630 ("trunk line") Turck RSM 571-*M/630 ("drop line")
• DIN rail (1 meter)	WRC 50022	Phoenix Contact NS 35/7,5 0801733 (2 m) Allen-Bradley 199-DR1 (1 m)

WRC also provides discrete and analog I/O signal conditioning and multiplexing on DeviceNet, as well as communication gateways. See Table 7-1 on the next page.

Table 7-1 Additional WRC DeviceNet Products

Part	WRC Part Number
DIN rail	WRC 50022
Terminating resistor, axial lead	RM121DN
Connector, 5-pin mini-round for CANX, CANR	B 4151-0/16 (Turck)
Discrete I/O block – 4 channels	1782-JDB4
Discrete I/O block – 8 channels	1781-JDB8
Analog Input block – 4 channels, 10-bit	1782-JDA4
Analog I/O block – 8 channels, 12-bit	1782-JDA8
DeviceNet to Serial I/O Gateway	1782-JDC
DeviceNet to Serial I/O Gateway, Enhanced	1782-JDCE
DeviceNet-to-Serial I/O Gateway, 4 channels	W5-JDC4
DeviceNet to Modbus Gateway	1782-JDM
Discrete I/O block – 24 channels	WRC1-JDB24
Discrete I/O block – 48 channels	WRC1-JDB48
Discrete I/O, Analog Input block – 24 DIO, 32 AI	WRC1-JDA/24
Discrete I/O, Analog Input block – 48 DIO, 32 AI	WRC1-JDA/48
Analog I/O block - 32 channels	WRC1-JDAIO
Discrete and Analog I/O block – 24 DIO, 32 AIO	WRC1-JDAIO/24
Discrete and Analog I/O block – 48IO, 32 AIO	WRC1-JDAIO/48
Discrete I/O block – 8 DIs, 8 DOs, 4 AIs	W5-JDB16x
DeviceNet, CANopen Extender, DIN mount	WRC-CANX-DIN-DN
SDS Extender, DIN mount	WRC-CANX-DIN-SD
DeviceNet, CANopen Extender, DIN mount	WRC-CANX-DIN-C7
DeviceNet, CANopen Extender, NEMA box	WRC-CANX-NEM-AU
DeviceNet, CANopen Extender, NEMA box	WRC-CANX-NEM-DN
SDS Extender, NEMA box	WRC-CANX-NEM-SD
DeviceNet, CANopen Extender, Fiber Optic, NEMA box	WRC-CANR-DF-DN

8.   Troubleshooting

This section identifies some of the common problem observed when commissioning or operating a CANX Extender.

Problem:
> DeviceNet devices will not communicate on the network
> Module Status LED is solid Green
> Network Status LEDs are flashing Green at ½ second intervals

Meaning
> No transmissions have been received by the CANX for 0.5 seconds.

Possible Solutions:
> 1.   Network cables are broken or disconnected.
> 2.   Network is not properly terminated.
> 3.   All devices have stopped trying to communicate on the network.
> 4.   Power has been lost on the B Side subnetwork.

Problem:
> DeviceNet devices will not communicate on the network
> Module Status LED is solid Green
> Network Status LEDs are flashing Green quickly

Meaning
> The CANX is in autobaud and is waiting for a valid message to fix its baud rate.

Possible Solutions:
> 1.   Network cables are broken or disconnected.
> 2.   Network is not properly terminated.
> 3.   All devices have stopped trying to communicate on the network.

Problem:
> Some messages are missed on network.
> Module Status LED is solid Green
> NSA and NSB LEDs are flashing Red

Meaning
> Internal CAN buffers are full. Network has more traffic than it can handle.

Possible Solutions:
> 1.   Reduce the scan rate from the Master.
> 2.   Reduce the COS frequency on I/O devices.
> 3.   Decrease the assembly sizes of I/O connections.
> 4.   Recalculate the network traffic and bandwidth without the CANX.

Problem:
> Some messages are missed on network.
> Module Status LED is solid Green
> NSA and NSB LEDs are flashing Red

Meaning
> Internal AMT buffers are full. Network has more traffic than it can handle.

Possible Solutions:
> 1.   Reduce the scan rate from the Master.
> 2.   Reduce the COS frequency on I/O devices.
> 3.   Decrease the assembly sizes of I/O connections.
> 4.   Recalculate the network traffic and bandwidth without the CANX.

9. Summary of Changes to Series 4 from Rev 2 and Series 3

To facilitate implementation of the new Series 3 CANX products for customers that are currently users of the CANX Revision 2.xx products, this section summarizes the product changes from Rev 2 to Series 3.

9.1. DIP Switch Baud Rate Settings

Several new options exist for setting the baud rate on the CANX Series 3.

- Like the Series 3, the Series 4 has an 8-position DIP switch block. All 8 switches are defined and used.

- The Series 4 unit is compatible with all CANopen baud rates. These baud rates are fixed by setting the 8 position dip switch to the appropriate configuration.

- Like Series 3, a "remote mode" exists which allows either side to set its baud rate based on the other side's BR – in either fixed baud or autobaud.

- See Section 4.2 above for details.

9.2. Terminating Resistors

The Series 4 has an on-board terminating resistor on each CAN connection that can be selectively included or excluded from the network circuit. With jumpers W1 and/or W3 in place, the CANX puts a 121-ohm resistor across the CAN_H and CAN_L lines on sub-network sides A and/or B. See Figure 4-1and Figure 4-2 for the location of these jumpers.

9.3. Field Programmable Updates

The CANX Series 4 has its program held in flash memory, which can be updated in the field. Contact the factory for details.

10. Frequently Asked Questions

1. ***On what networks do the WRC CANX and CANR work?***

   The WRC CANX and CANR function with DeviceNet, CANopen, J1939, SDS and other CAN 2.0, Part A and Part B networks. If you don't see your network listed here contact WRC for more information on your network compatibility.

2. ***What's the difference between WRC-CANX-xx and WRC-CANR-xx product families?***
   The primary difference between the two different extender families is the way in which the CAN messages travel. The WRC CANX handles all message transfer internally, while the WRC CANR sends the messages across a fiber link.
   - The WRC-CANX-xx family is a group of single unit CANbus extenders. The unit receives a CAN message on one side and transmits it, without processing or modifying the message, on the other side. It is one unit with two CANbus connectors, one for each "network side."

   - The WRC-CANR-xx is a set of two CANbus extenders. The first unit receives CAN messages and transmits them over a fiber link to the other extender, which receives them, then reproduces the messages on the CANbus without processing or modifying them.

3. ***What are all of these different models? Which WRC CANX or CANR should I choose?***
   We offer many different models of the CANX and CANR in order to meet a wide range of customer needs. The following table provides descriptions of each available CANX and CANR model.

Table 10-1 CANX and CANR Models

Product Type	Model	Description
WRC-CANX	DIN-C7	1 extender with Phoenix connectors. Open frame, DIN rail mounted. Includes protective plexi-glass cover.
	DIN-DN	1 extender with Phoenix connectors. Open frame, DIN rail mounted.
	DIN40K	1 extender with Phoenix connectors. Open frame, DIN rail mounted. Switches preset for 40K baud rate.
	DIN960	1 extender with Phoenix connectors. Open frame, DIN rail mounted. Switches preset for 9.6K baud rate.
	NEM-DN	1 extender with M18 connectors. Comes in protective NEMA 4X box.
	NEM-40K	1 extender with M18 connectors. Comes in protective NEMA 4X box. Switches preset for 40K baud rate.
	DN-HK	1 extender with M18 connectors. Comes in protective NEMA 4X box. DNET power wired from side A to side B-no isolation.
WRC-CANR	DF-DN	Kit includes 2 extenders with M18 and fiber optic connectors. For use with multi-mode fiber optic cable.
	DF-SM	Kit includes 2 extenders with M18 and fiber optic connectors. For use with single-mode fiber optic cable.
	DIN-DF	Kit includes 2 extenders with Phoenix connectors. For use with multi-mode fiber optic cable. Open frame, DIN rail mounted.
	MTGKIT	Mounting kit for DIN rail. For use with CANX or CANR.

4. ***Why does WRC offer CANX & CANR extenders?***

The WRC-CANX/R Extenders are a family of products that extend the communications cable lengths for DeviceNet, J1939, CANopen and other CAN, V2.0, Part A or Part B serial bus systems. These repeaters serve to:

- extend a network beyond its absolute maximum length (e.g., 500 meters for DeviceNet) at the slowest speed
- implement a longer network for a given baud rate (e.g., pushing a 500K baud network beyond 100 m for DeviceNet)
- provide higher speed baud rates for a given network length
- extend the length of the drop cable (e.g., longer drops than 6 m for DeviceNet)
- provide 2500V electrical isolation between 2 sub-nets.
- allow the user to employ non-linear network topologies (e.g., star, tree, etc.)

5. ***What types of connections are available for WRC CANX and CANR extenders?***

Please see question 3 if you need to know what connectors come on which WRC CANX or CANR models.

Several of the WRC CANX and CANR extenders come with the 5-pin CANbus connection plug, which accepts cable sizes from 12 AWG - 24 AWG. This is the standard round, mini-style connector (M18) with male pins for copper cable. A standard DeviceNet cord with a female end connects to the CANX or CANR.

- Turck supplies individual connectors ends that can be used to build custom DeviceNet or copper cables (part number B4151-0/16 is a 5 pin, 600V, 9A connector that comes in a male or female variety that will connect to the CANX or CANR). Please refer to www.turck.com to find a distributor near you.

- If you are interested in purchasing pre-fabricated cables with the proper DeviceNet connectors, Brad Harrison is the manufacturer of Woodhead P/N 105002A01F030 (male pins) and Woodhead P/N 105000A01F030 (female pins), which are distributed by Gross Automation at http://www.bradharrisonsales.com/ along with many other 5-pole plug in options. All Woodhead products that are compatible with WRC CANX and CANR are called "mini-change" cordsets.

- Standard Phoenix connectors for use with non-NEMA enclosed units will be supplied with your order if you choose a model using these connectors.

- WRC CANRs use fiber optic receiver/transceivers that are compatible with different fiber grades, so long as they are terminated with ST fiber connectors.

6. ***At what baud rates do the WRC CANX and CANR function?***

The WRC CANX and CANR function at baud rates of 9.6K, 10K, 20K, 40K, 50K, 100K, 125K, 250K, 500K, 800K and 1M fixed and will auto-detect the baud rate on DeviceNet. The CANX and CANR are also capable of handling different baud rates on each side (e.g., a network with a baud rate of 125K plugged into Network side A can communicate with, through the CANX or CANR, a network with a baud rate of 1M on Network side B).

7. ***Does the WRC CANX or CANR require additional termination resistance on the data lines?***

The WRC CANX or CANR functions as the beginning or ending of a new segment of the network. With no power supplied to the network, the resistance across the CAN data lines should be approximately 60 ohms (two 120-ohm resistors in parallel—one on each "end" of the network bus).

- The WRC CANX has two user-selectable 121-ohm resistors on board. Keeping the plastic jumpers, which are installed on all units at the factory, on W1 and W3 will keep these resistors in the circuit, across the CAN data lines. In this case, the user needs only to terminate the other end of each side of the bus with a 120 ohm resistor to insure correct termination on Network side A (on one side of the CANX) and Network side B (on the other side of the CANX). If your network is already terminated at the beginning and end of the bus (net resistance of ~60 ohms), it will be necessary to take the W1 or W3 jumpers off so that the network is not improperly terminated.

- The WRC CANR has one user-selectable 121-ohm resistor on board, which is selected or deselected using the plastic jumper (installed on all units at the factory) on W1. With the jumper on, this resistor remains in the circuit across the CAN data lines. In this case, the user needs only to terminate the other end of the bus with a 120-ohm resistor to insure correct termination. If your network is already terminated at the beginning and end of the bus (net resistance of ~60 ohms), it will be necessary to take the W1 jumper off so that the network is not improperly terminated.

  ➢ It should also be noted that drop lines should not be terminated where they are connected to the main trunk line. For a CANX or CANR in this position the jumper will have to be removed. See the diagrams below for further clarification of proper network setup.
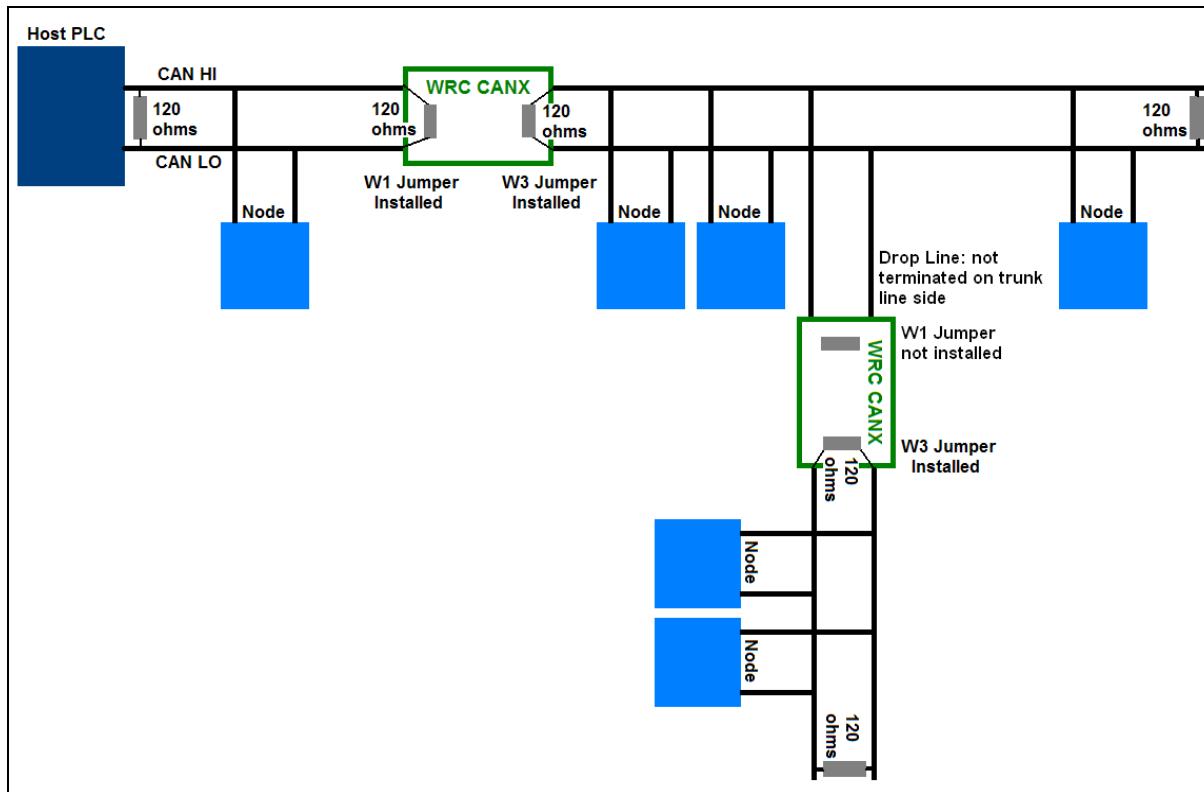

Figure 10-1 Sample WRC-CANX Setup

8. ***How do I determine the location in my network at which I might need a WRC CANX or CANR?***

- Drop Line: The WRC CANX or CANR should be used in a drop line when you would like to extend the drop more than 6m.

- Trunk Link: The CANX or CANR should be used in the main trunk line when you desire to extend a network beyond its maximum length (e.g., 500 meters for DeviceNet at 125K baud rate or beyond 100 m for DeviceNet at 500K baud rate)

- Differences in baud rate: The WRC CANX and CANR can pass communications from two different baud rates back and forth with each other (e.g., Network A at 125K and Network B at 500K)

- Isolation: The CANX and CANR can provide 2500V electrical isolation between 2 sub-nets.

9. ***Does the WRC CANX or CANR act as a node on the network?***

No. The WRC CANX and CANR are repeaters, which remain completely invisible to the master device or PLC. The unit does not have a MAC ID. It will only pass messages through (without modifying them) and cannot generate its own messages.

10. ***How much power does my WRC CANX or CANR require and what is the best means of supplying it?***
The WRC CANX and CANR should be powered with 11-25Vdc provided by the DeviceNet network, or other DC power supply. The WRC CANX and CANR Series 4 consume approximately 1.5W (60mA at 25Vdc). Power is typically taken from the bus on each side and each side (A and B) requires power. Power applied to the A Side powers the entire unit except the B Side isolated transceiver. If isolation is not required for your application, then the power line may be jumpered from side A to side B. Care must be taken that the power supply is capable of handling the entire load on both sides of the CANX.

11. ***Is there a limit to the number of times a network can be extended using a WRC CANX or CANR?***
There is no technical limit to the number of WRC CANXs or CANRs that can be placed in a network. The number of extenders in a network is generally dictated by the length limitations, due to the operation baud rate, of the network desired. Also, although the CANX and CANR have very small propagation delays, their delay times add up when there are multiple units on one network. For this reason, the master device's EPR time should be adjusted to be greater than the message transmission time (which includes the transmission time on the data lines plus the propagation delay of the CANXs or CANRs) when adding several CANXs or CANRs to your network.

12. ***How do I know how many WRC CANXs or CANRs my application will require?***
While there is no set formula for determining the number of WRC CANXs or CANRs, the length of the network you are trying to create is most likely the dictating factor in the answer to this question. The lengths of drop and trunk lines must follow CANbus guidelines for the selected protocol. A CANX or CANR should be added in the network whenever you desire to extend the length of a drop or trunk line beyond the normal maximum allowed length. Please refer to the WRC CANX or CANR User's Manual section "Cable Lengths" for more information on the allowed cable distances for each baud rate and network protocol.

13. ***What do the LEDs on the WRC CANX or CANR tell me about how the unit(s) are behaving?***
The Network LEDs on a CANX will be green and blinking slowly if a connection is established, but no messages are being transmitted/received. They will be solid green when messages pass. These same LEDs will be red if there is no connection. The same diagnostics apply for the NSA LED of a CANR, but the NSB LED of a CANR indicates the status of the remote unit and whether the fiber

link is hooked up correctly (blinking green with no messages, solid green with messages) or incorrectly (red). The MS LED gives the status of the unit. If it is green the unit is operating normally. If it is blinking red the unit is out of memory, while solid red means the device has failed and may be need to be power cycled or be repaired. Please refer the WRC CANX or CANR User's Manual and see the section on "LED Operation."

14. **Do WRC CANX and CANR extenders cause signal delays, and what speed of messages can they handle?**

The WRC CANX has a small propagation delay of approximately 810µs, while the CANR has a delay of about 880µs. The Series 4 units have increased buffer sizes from Series 3 and faster message forwarding as well.

15. **What testing has WRC completed to guarantee the reliable operation of CANX and CANR extenders?**
The WRC production and engineering teams have rigorously tested the CANX and CANR extenders at a variety of strenuous network speeds and environmental conditions with many different network configurations. Although there is no official ODVA test for this type of device, the CANX and CANR have been included in the circuit while running the ODVA conformance testing for a slave device. The slave device passed WRC's in-house protocol conformance test with the CANX or CANR in the circuit, between the master and slave. The CANX and CANR also passed the in-house execution of the OVDA physical layer test. Each CANX or CANR pair is tested for functionality individually before leaving our facility.

16. **How does the Series 4 WRC CANX or CANR differ from the Series 3 model?**

Single Mode fiber cable is now an option, available with the Series 4 CANR. New switch settings allow selection for CANopen speeds up to 1M baud in addition to the standard DeviceNet baud rates. There are larger internal buffers, which allow the WRC CANX and CANR to store more messages while forwarding them in a first-in-first-out manner, making it even less likely that a message will ever be lost in transmission. There is shorter latency time compared to CANX and CANR series 3. The CANX and CANR also feature improved reverse voltage protection and CAN data lines noise immunity.

17. **Does the WRC CANX or CANR come with a warranty?**
Yes, the WRC CANX and CANR, like all WRC products, are covered under a two year factory warranty from the date of invoice that all hardware furnished under order will be free from defects in material, workmanship and design.

18. **How are field programming updates accomplished?**

In the event that your WRC CANX or CANR is in need of an update, contact WRC. We will discuss with you the options you have for your network.

If the answer to your question is not found here, or you require further assistance, please contact Western Reserve Controls at:

1485 Exeter Road
Akron, OH 44306
330-733-6662 (phone)
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For product information, e-mail: sales@wrcakron.com
For technical support, e-mail: support@wrcakron.com